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Use of Organic Acid Salts to Control *Listeria monocytogenes* on Processed Meats

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Summary and Implications

Four organic acid salts including sodium lactate, sodium diacetate, potassium benzoate and potassium sorbate were evaluated, alone and in all combinations, for inhibitory effectiveness against *Listeria monocytogenes* on ready-to-eat (RTE) meats. Sodium diacetate alone, sodium diacetate + potassium benzoate and sodium lactate + sodium diacetate + potassium benzoate were most effective for inhibiting growth during storage. These results indicate that sodium diacetate provides an effective means of improved control of *L. monocytogenes* on RTE meats.

Introduction

Processed, RTE meat products such as frankfurters have been the source of several *L. monocytogenes* illness outbreaks and the United States Department of Agriculture Food Safety Inspection Service (USDA-FSIS) has established a zero tolerance policy for this organism on RTE products. Consequently, new ingredients and processes for improved control of *L. monocytogenes* on RTE products are critical to continued production of these products. The salts of several organic acids including lactate, acetate, sorbate and benzoate, have been reported to be significant antimicrobial agents. These salts have been suggested as significant means to control *L. monocytogenes* on RTE meats. More importantly, however, these salts, in combination, may offer synergistic effects that would allow use of lower concentrations than when used alone. Therefore, a study of organic acid salts, alone and in combination, was initiated to determine effectiveness for control of *L. monocytogenes*.

Materials and Methods

Frankfurters were prepared for this study using conventional processing. Finished frankfurters were then dipped in 3% or 6% solutions of sodium lactate, sodium diacetate, potassium benzoate or potassium sorbate, alone and in all combinations. Dipping for 3 minutes achieved 0.08% total pickup of the compounds. Frankfurters were then placed in vacuum bags and inoculated with a 5-strain cocktail of *L. monocytogenes* before the packages were

sealed. Storage of packaged frankfurters was at -2.2, 1.1, 4.4, 10.0 or 12.8°C for 90 days. Packages were analyzed for *L. monocytogenes* survivors every 48 hours. Three growth parameters, lag phase duration, generation time and maximum population density were calculated from the growth data to compare treatment effectiveness.

Results and Discussion

Preliminary results identified three treatments, sodium diacetate alone, sodium diacetate + potassium benzoate, and sodium lactate + sodium diacetate + potassium benzoate that had the greatest initial impact on *L. monocytogenes*. Consequently, these three were utilized for comparison of effectiveness during an extended storage period and at a range of storage temperatures. Of the growth parameters determined, maximum population density provided the best comparison of the treatments. The results for maximum population density are shown in Table 1. The treatment with 6% sodium diacetate alone resulted in the lowest population density at -2.2, 1.1 and 4.4°C. However, a high degree of variation in the means resulted in limited statistical differences. At the same time, coupled with the other measures of *L. monocytogenes* growth, sodium diacetate was consistently the most effective. It should be noted that, regardless of the treatment, *L. monocytogenes* growth occurred, and temperature was the singly most important determinant of growth. Therefore, organic acid salts such as sodium diacetate offer some improvement in control of *L. monocytogenes* on RTE meats but would be best coupled with additional inhibitors to achieve more complete inhibition of this organism.

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Table 1. Effects of inhibitors on the maximum population density (Log CFU/g) of *L. monocytogenes* on frankfurters

Treatments	Treatment		Temperatures (°C)									
	Mean ¹		-2.2		1.1		4.4		10.0		12.8	
Control	5.30	ab	0.95	a A	4.52	b B	6.65	ab B	6.96	a B	7.00	a B
3%SD	5.59	a	1.38	a A	5.75	b B	6.39	ab B	7.16	a B	7.30	a B
6%SD	4.23	b	0.74	a A	0.82	a A	4.43	a B	7.75	a C	7.44	a C
3%SL/SD/PB	4.69	ab	2.14	a A	4.19	ab AB	5.18	ab B	5.54	a B	6.41	a B
6%SL/SD/PB	5.54	a	1.84	a A	3.10	ab A	7.42	b B	7.55	a B	7.82	a B
3%SD/PB	5.13	ab	1.63	a A	3.17	ab A	6.30	ab B	7.62	a B	6.95	a B
6%SD/PB	5.01	ab	1.22	a A	3.51	ab A	6.44	ab B	7.06	a B	6.83	a B
Temperature mean ²			1.41	A	3.64	B	6.12	C	7.09	C	7.11	C

¹Overall mean across all temperatures (–2.2, 1.1, 4.4, 10.0 and 12.8 °C) for each treatment

²Overall mean across all treatments at each temperature (–2.2, 1.1, 4.4, 10.0 and 12.8 °C)

Different letters A-C within each row indicate significant differences ($P \leq 0.05$)

Different letters a-b within each column indicate significant differences ($P < 0.05$)